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FIRST-YEAR SCIENCE IN ILLINOIS HIGH SCHOOLS

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At the present time there is considerable dissatisfaction with the science work of the high school. This is showing itself in the form of experiments with modified courses, in segregation of the sexes, in the introduction of courses in agriculture and other branches of technology, and, so far as the first year is concerned, by a vigorous movement toward general science. Since the first year is naturally the primary point of attack in any scheme for the revision of the science schedule of the high school, it appeared to be worth while to attempt to ascertain more precisely the actual practice of the schools, at least in one state. The schools of Illinois were chosen for the investigation because of proximity.

In the autumn of 1912 a list of questions was sent to the principals of 417 of the 432 schools which are listed as township high schools and four-year high schools in the *School Directory* for 1911-12, as issued by the Superintendent of Public Instruction. By the kindness of Superintendent F. G. Blair it was possible to inclose with this list of questions a letter from him requesting the co-operation of the school authorities. The total number of reports received as the result of considerable correspondence is 203. The table below shows that the schools reporting include a fairly proportionate representation of schools of all the different sizes. The data secured from them may therefore be regarded as fairly typical of the schools of the state.

TABLE I
SCHOOLS REPLYING COMPARED WITH WHOLE NUMBER OF SCHOOLS IN STATE

	1-25	26-50	51-100	101-200	201-400	401-800	Over 800
Number pupils. . . .							
Total number of schools.	34	98	146	73	30	20	16
Number of schools replying.	8	45	61	35	28	14	12

The questions were designed to elicit information regarding the science subject or subjects offered in the first year, the training of the teachers, other subjects taught by first-year teachers, and the efficiency of the work. In most cases definite replies were given to all questions although in a few cases certain statements were so unsatisfactory that it was necessary to reject them. As a result of unsatisfactory statements or omissions, the number of replies recorded for each question is less than the whole number of papers returned. The results secured are included in the tables below. The replies appear to have come from the principal in most cases, but in a few schools the matter was apparently turned over to the science teacher.

TABLE II
SCIENCE SUBJECTS ADMINISTERED IN THE FIRST YEAR

SUBJECT	REQUIRED		ELECTIVE		SCHOOLS REPRE- SENTED	UNITS
	$\frac{1}{2}$ Year	1 Year	$\frac{1}{2}$ Year	1 Year		
Physiography.....	40	.....	37	.....	77	77
And Physiology.....	57	.....	20	.....	
Physiography.....	22	.....	10	.....	32	32
And Biology, Botany, Zoölogy.	22	.....	10	.....	
Physiography and Agriculture.....	.....	.....	.....	I	I	I
Physiography.....	11	2	3	6	22	15
Geography.....	.....	3	.....	I	4	4
Botany.....	2	4	I	I	8	6.5
Zoölogy.....	I	.....	.....	.....	I	.5
Botany and Zoölogy or Biology...	2	5	I	2	10	8.5
General Science.....	2	4	.....	.....	6	5
General Science.....	4	.....	I	.....	5	5
And another subject.....	3	.....	2	.....	
Physiology.....	2	.....	2	I	5	3
Broad election permitted, agriculture often included.....					9	.....
No science in first year.....					22	.....

In Table II it is shown that physiography and geography appear in the first year, either alone or in combination with other subjects, in 136 schools; physiology is found in 82 schools; and the biological sciences other than physiology are given in 51 cases. General science has been introduced into the first year in 11 schools and agriculture into the same year in not to exceed 10 schools. The presence of physiology is to be accounted for largely by the requirements of state law and this fact was mentioned in many of the replies.

It is noted that in only three cases (Table III) is the amount of time given to the science work so small as four periods per week. In

169 out of 180 schools either five or seven periods per week are reported and it may be remarked in passing that the same reports show that the forty-five-minute period is practically universal. One is tempted, however, to question whether the instruction is generally

TABLE III
DISTRIBUTION OF TIME IN SCIENCE CLASSES

TOTAL PERIODS PER WEEK		LABORATORY PERIODS PER WEEK						
Number of Periods	Number of Schools	0	1	2	3	4	10	No Reply
4.....	3	1	.....	2	.....	.....	.....	.....
5.....	112	43	22	26	8	1	4	12
6.....	6	.....	2	4	.....	.....	.....	.....
7.....	57	.....	.....	6	2	49	.....	.....
8.....	0	.....	.....	.....	.....	.....	.....	.....
9.....	0	.....	.....	.....	.....	.....	.....	.....
10.....	2	.....	.....	.....	.....	.....	.....	2

of truly scientific character when it is noted that the amount of time given to laboratory work is no more than one hour per week in 40.4 per cent of the schools reporting, and that in only 30 per cent of the schools does it reach four periods.

TABLE IV
TRAINING OF TEACHERS BY SCHOOLS

Years in	$\frac{1}{2}$	1	2	3	4	5	6	7	8	No Reply	Totals
High school only.....	.....	.....	.....	.....	2	.....	.....	.....	.....	1	3
Normal school only.....	4	3	5	4	6	1	.....	.....	.....	7	30
Normal and college.....	.....	2	1	5	4	4	1	1	.....	6	24
College and graduate.....	3	5	8	1	68	23	3	.....	.....	12	123

Number with more or less college training..... 147

Number with more or less normal training..... 54

It is obvious that the teachers of first-year science are almost wholly college trained and have usually done work equivalent to that required for the degree of bachelor or master. The college which criticizes the work of the high schools needs to look well to its own record, for apparently the high-school teachers are very much what the colleges make them. The necessity of professional courses for prospective teachers is strongly suggested to the colleges.

TABLE V
TRAINING OF TEACHERS, BY SUBJECTS

Department	Number		
Physiography.....		8	
Botany.....	7		
Zoölogy.....	2		
Physiology.....	2		
Biology.....	32		
Total.....		43	
Physics.....	6		
Chemistry.....	13		
Physics and Chemistry.....	2		
Total.....		21	
"Science".....		50	
Total science.....			122
Agriculture.....	0		
Domestic science.....	3		
Manual training.....	1		
Total arts, etc.....		4	
Mathematics.....		10	
Non-science, scattering.....	8		
Language.....	15		
Education.....	2		
Total.....		25	
Total non-science.....			39
Total teachers represented.....			151

It is encouraging to note that the majority of teachers who are giving science instruction are trained in science, but at the same time one is compelled to recognize that very few of them have had their principal training in the sciences which they are teaching to first-year pupils. As against the 136 schools in which physiography is a first-year subject there are but eight teachers who name physiography as the subject in which they have had their principal preparation. There are but two teachers distinctively trained in physiology as against 82 schools offering the subject. It is not our province to suggest the reasons for this other than to call attention to the following table in which are data showing the large number of cases in which a teacher has charge of classes in several different

subjects. Obviously, one cannot have had his principal preparation in five or six different subjects.

TABLE VI
NUMBER OF SUBJECTS PER TEACHER

Number of Subjects Other than First-Year Science	Teachers
0.....	9
1.....	9
2.....	31
3.....	40
4.....	25
5.....	22
6.....	13
7.....	4
8.....	0
9.....	2
Total reported	155

Total of teachers handling 3 or more subjects in addition to first-year science. . . .	106
Percentage with at least 2 additional subjects.	89
“ “ “ “ 3 “ “	69
“ “ “ “ 4 “ “	40
“ “ “ “ 5 “ “	26

It is frequently asserted that it will be impossible to secure teachers for general science courses because of the breadth of the preparation required. This view can scarcely be held in Illinois since the figures show that the teachers in many schools are actually giving instruction in all or nearly all of the high-school sciences. In some cases non-science subjects are added to the list. The teaching is doubtless inefficient in many of these cases and it might be improved by greater specialization in teaching if this were possible. Such specialization usually is possible only in schools of 400 pupils or more. There are in the state but thirty-six schools of this size and twenty-eight of them are represented in the reports. The fact that these data refer only to the first year does not invalidate conclusions since there are more pupils of this grade than of any other and the opportunity to restrict a teacher's work to a single subject is correspondingly greater. It appears, therefore, that the abundance of small schools will compel the larger number of teachers of science to give instruction in several sciences and frequently to add non-science subjects to their work.

The way out of the difficulty does not lie through greater

specialization of the teacher's work in the school, for that can be accomplished only in the large schools of urban places. The schools of the villages and smaller towns must remain small on account of the limited school population. The only practical remedy for the situation appears to lie in securing greater breadth of training for the teacher. The tendency of the college is to encourage specialization on the part of its students rather than general training. However, there is need here of some distinction between those who are to go into research and those who are to teach. Specialization is essential to the investigator but it may very easily be carried so far in the case of the prospective secondary-school teacher that he is wholly unfitted for his task. Such unfitness will result not from the acquisition of knowledge in the special line pursued, but from the omission of many other related lines. The average high school has little place for the science teacher who is not prepared to teach any or all of the usual high-school sciences.

TABLE VII
EFFICIENCY CORRELATED WITH PREPARATION OF TEACHER

EFFICIENCY OF THE COURSE	PREPARATION OF TEACHER		
	In Same Science	In Other Science	Non-Science Subject
	Per cent	Per cent	Per cent
Satisfied.	39.9	23	10.8
With some reservations.	37.9	44.5	30
Not satisfied.	24.2	32.4	59.2
Number reporting.	37 Schools	74 Schools	37 Schools
Total schools reporting above.	148		
Total not wholly satisfied.	113		
Percentage not wholly satisfied.	76.3		

The amount of dissatisfaction with the work of the first year in science is very great. In some cases at least this is to be attributed to the lack of preparation on the part of the teachers, for the dissatisfaction is almost universal in those schools in which this work is in the hands of teachers whose principal interest lies in other directions. Only four of these teachers gave satisfaction. There is, however, much dissatisfaction in those schools where the teachers have been

trained in the subject or in related sciences. The difference in results secured by teachers trained in the science taught and those secured by teachers principally trained in other sciences is evident but not large. The replies to the questions here involved were commonly made by the principal, though in a few cases it was clear that the matter had been referred to the teacher.

In this connection it is interesting to note the causes for poor results as assigned by reports. These are presented in Table VIII. The sum of the replies does not in this case represent the number of schools replying since many schools gave more than one reason for unsatisfactory results.

TABLE VIII

CAUSES RESPONSIBLE FOR UNSATISFACTORY RESULTS

Time too short	30	
Too much work for teacher	22	
Classes too large	9	
		61
Subject not suited to pupil or pupil not well prepared by lower school	45	
Teacher or teaching	37	
Poor textbooks	10	
		92
Inadequate library	3	
Inadequate equipment	59	
Lack of field and laboratory work	9	
Lack of significance to pupils	2	
		73

The conditions under which the teacher works, the equipment, and the textbooks are charged with responsibility for the failure in 133 of the 226 cases here tabulated. All of these matters are within the control of the school system and in the main demand financial remedies. It is of interest to note that the equipment comes in for more blame than any other single factor, though with an enlightened school sentiment in the community it ought to be the factor most easily dealt with. The teacher does not appear to bear as great burden of responsibility as the correlation of result with training would indicate. It is quite probable that the school officers concerned have not analyzed their problems very deeply and that the satisfaction of the material needs of the schools, such as equipment, would leave the schools very little in advance of their present position.